# *On the Explosion of Pure Electrolytic Gas.*

By Harold B. Dixon, M.A., F.R.S., Professor of Chemistry, and Lawrence Bradshaw, M.Sc., late Dalton Scholar of the University of Manchester.

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[Plates 2 and 3.]

The fact that a large number of chemical reactions have been shown to be dependent on the presence of aqueous vapour has led to many experiments being made on the union of hydrogen and oxygen. Some years ago one of us* made experiments which showed that an electric spark would fire ordinary electrolytic gas, whether in the dried or the moist state; and experiments on the rate of detonation in electrolytic gas seemed to show that, once an explosion-wave was started, no influence was exerted on the propagation of the wave by aqueous vapour, except a slightly retarding one.

More recently, H. B. Baker† carried out a series of experiments with very pure hydrogen and oxygen obtained by the electrolysis of a solution of highly purified barium hydroxide. His results show that the initiation of the flame by a heated wire is largely influenced by the purity of the gases.

If the interaction of hydrogen and oxygen depends upon the presence of previously formed water molecules, it appeared probable that there might be a difference in the rate at which the flame spread when initiated by a spark in the moist and dried gases.

With a view to finding whether or not there is any such difference, either in the initial stage of the explosion or in the subsequent phenomena, we have made a photographic analysis of the explosion flame in the dried and undried gases. The photographs were taken on a film moving vertically downwards with great rapidity, while the flame, started by a spark between platinum wires in a Jena glass tube, travelled horizontally towards either end.

*Experimental Part.*—The Jena glass explosion-tubes were cleansed successively with distilled water, a mixture of sulphuric acid and potassium dichromate, and fuming nitric acid, and finally washed with distilled water. After draining, they were dried first in a steam oven and then by heating in a furnace, while at the same time a stream of hot air, filtered through cotton wool and dried by means of $P_2O_5$, was drawn through them.

*Preparation of Pure Materials.*—The gaseous mixture was prepared by Baker's method, viz., by electrolysing an aqueous solution of barium

* H. B. Dixon, 'Phil. Trans.,' 1884, p. 634, and 'Chem. Soc. Trans.,' 1886, p. 108.

† 'Chem. Soc. Journ.,' vol. 81, p. 401, 1902.

Fig. 1.—Dry.

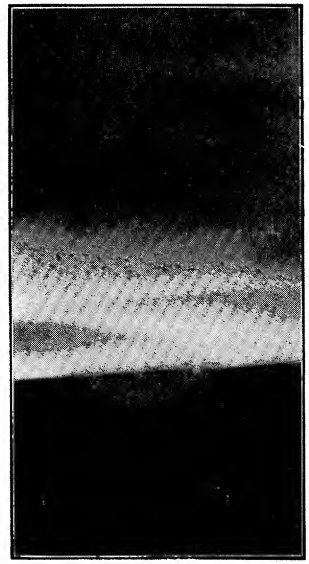


Fig. 2.—Moist.

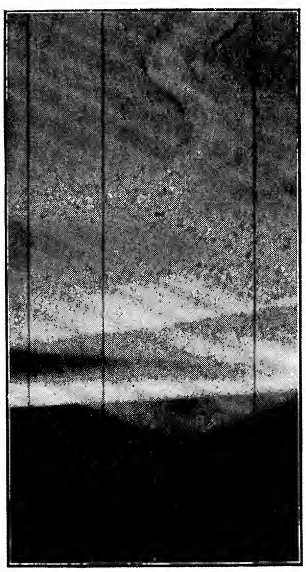


Fig. 3.—Dry.

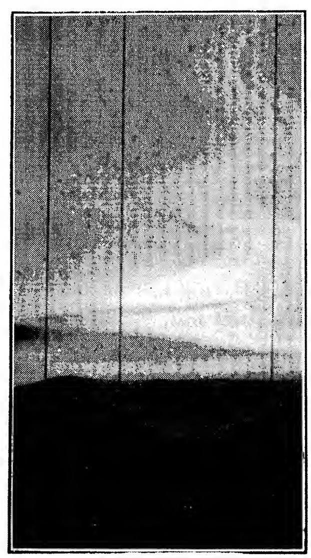


Fig. 4.—Moist.

*** Figs. 3 (Plate 2) and 5 (Plate 3) do not show the dim lower part of the flame; the original films show them of nearly equal intensity with the same parts in the "moist" gases (figs. 2 and 4, Plate 2).

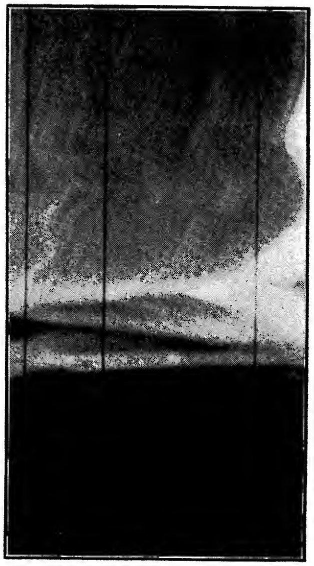


Fig. 5.—Dry.

Fig. 6.—Moist.

Fig. A.

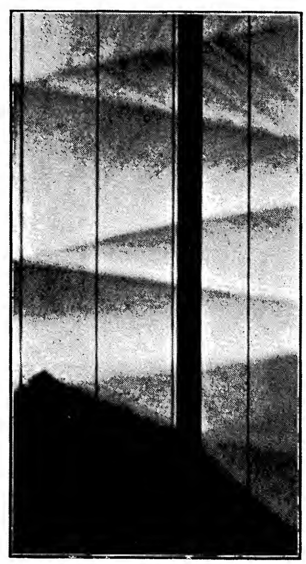
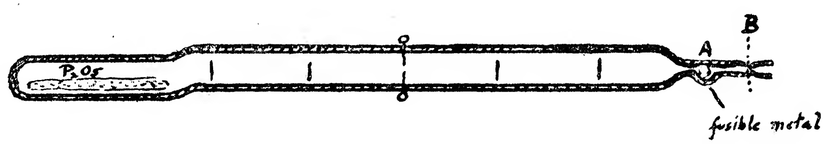


Fig. B.

hydroxide. For experiments with undried gases, the mixed hydrogen and oxygen were collected directly over mercury in a glass gas holder. For the experiments with dry gas, the mixed gases from the electrolytic cell were roughly dried by passing through two tubes of redistilled $P_2O_5$, and were collected in a holder over mercury, upon the surface of which rested some $P_2O_5$. The tubes (each containing a quantity of $P_2O_5$) were filled from this holder.

The barium hydroxide was obtained by several recrystallisations of Kahlbaum's "pure" $Ba(OH)_2$; it still contained a small quantity of carbonate. The phosphorus pentoxide was redistilled in a stream of dry oxygen over platinised asbestos.

The tubes were washed out several times with the mixed gases and were then sealed with fusible metal (at A in illustration), after which they could be safely drawn off (at B) in the blow-pipe flame.




*1st Series* (July to September, 1902).—Three tubes into which a quantity of $P_2O_5$ had been introduced were filled with the mixed gases and were allowed to stand in the dark for two months. Three control tubes (moist gases) were prepared at the same time and also left standing. Of these the photographs 1 and 2 (Plate 2) were the most successful; 1 shows the explosion of the dried gases, 2 the moist. They appear to agree in every respect.

A *2nd series,* carried out in the same way, confirmed these results.

*3rd Series* (April to July, 1903).—To make the conditions more nearly alike, a quantity of finely powdered $SiO_2$, equal in bulk to the $P_2O_5$ in the dry-gas tubes, was introduced into the tubes containing the moist gases. The tubes remained in the dark for two and a-half months.

Photographs 4 and 6 (moist) are comparable with 3 and 5 (dry) (Plates 2 and 3). These photographs confirm those of Series I. The effects observed in the moist and in the dry gases are identical. The dark, vertical lines seen on the photographs are caused by thin bands of dark paper gummed on the explosion tubes to serve as reference marks.

Our experiments show that, as far as can be judged from the flame, the absence of water vapour does not influence the explosion of a mixture of hydrogen and oxygen once the flame has been started by a spark.

Fig. 1.—Dry.

Fig. 2.—Moist.

Fig. 3.—Dry.

Fig. 4.—Moist.

*** Figs. 3 (Plate 2) and 5 (Plate 3) do not show the dim lower part of the flame; the original films show them of nearly equal intensity with the same parts in the "moist" gases (figs. 2 and 4, Plate 2).

FIG. 5.—Dry.

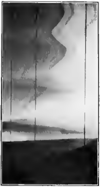


FIG. 6.—Moist.

FIG. A.

FIG. B.